Covid-19 report: Update on the current epidemic status in Luxembourg

17 February 2022

Authors: Atte Aalto, Silvia Martina, Daniele Proverbio, Stefano Magni, Françoise Kemp, Paul Wilmes, Jorge Goncalves, Alexander Skupin

Background information
This report has been elaborated by the Research Luxembourg Covid-19 Task Force to inform the Luxembourg Government about the current epidemic status in Luxembourg as an update to the last report from 10 February. It gives a short overview on the most important epidemic indicators and contains projections for the current epidemic status **based on data available up to 16 February**.

Main conclusions

- **The development during the current week exhibits a continuing relaxation in the epidemic dynamics with a faster trend than anticipated from the projections of last week** probably facilitated by the current vacation period**.** Thus, the 7-day average of daily cases for the current week has decreased to 605 cases/day compared to 1,217 cases/day for the week before, which corresponds to a 50% decrease compared to a 35% decrease last week.
- **R_{eff} of today has remained constant at 0.61** compared to 0.6 on Thursday of last week (Figure 1). The 7-day average value of R_{eff} has decreased significantly to 0.62 for this week compared to 0.77 for the previous week.
- The relaxing dynamics during the current week follows the exponential decay as anticipated from last week's projections. A linear fit of the cumulative cases for the last month indicates a decreased slope of 1,789 cases/day compared to 2,100 cases/day for last week reflecting the relaxation during the fitting period (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has strongly decreased** compared to last week (55.7 cases on average for this week compared to 73.4 cases for last week). The average **ICU occupancies has remained** constant with 10.4 cases on average for this week compared to 9.7 cases for last week.
- Based on the relaxing trend of the epidemic dynamics, the current **midterm projections of daily cases indicate a continuing decrease** in case numbers for the next weeks with approximately 300 cases/day on average in beginning of March which might slightly increase again after the current vacation period (Figure 4).
- The corresponding **projections for the hospitalization demands** reflect the apparently milder disease progression for the Omicron variant by a reduction of 60% for normal care hospitalization and 80% reduction of ICU hospitalization for the Omicron variant in comparison to the Delta variant. Given these assumptions, the projections indicate a decreasing demand in normal care demands with around 25 beds beginning of March (Figure 5). With the adapted assumption for disease severity, the current projection for ICU demands indicates a decrease with around 5 beds on average at the beginning of March (Figure 6). Note that hospitalization and specifically ICU demands depend strongly on the age structure of the cases and the vaccination status of the population. Hence, it is important that vulnerable people are fully vaccinated and remain cautious in their social interactions to prevent severe cases and an increase in hospital demands.
- The **average positivity rate has decreased** to around 20% compared to 28% for last week (Figure 7).
- The total number of **estimated active cases has decreased by 40% to 14,890** cases compared to 24,729 cases for the previous week (Figure 8).

As anticipated from the projection of last week, the epidemic dynamics exhibits a further relaxation with a slightly faster decay than expected potentially driven by the school break. Furthermore, the evidence for a reduction in the hospitalization rate for the Omicron variant in comparison to the Delta variant has manifested in a reduction of 60% for normal care and an 80% reduction of ICU demands leading to further relaxations in the health care system. Nevertheless, sustained efforts in social distancing, in following hygiene measures as well as in vaccination uptake, including booster shots, remain essential to support the epidemic relaxation. Monitoring immunity waning and virus variants will be key to mitigate potential future epidemic rebounds.

Graphical analysis of epidemic indicators

Below, the epidemic indicators are visualized and analyzed in more detail including the midterm projections for daily cases and hospitalization.
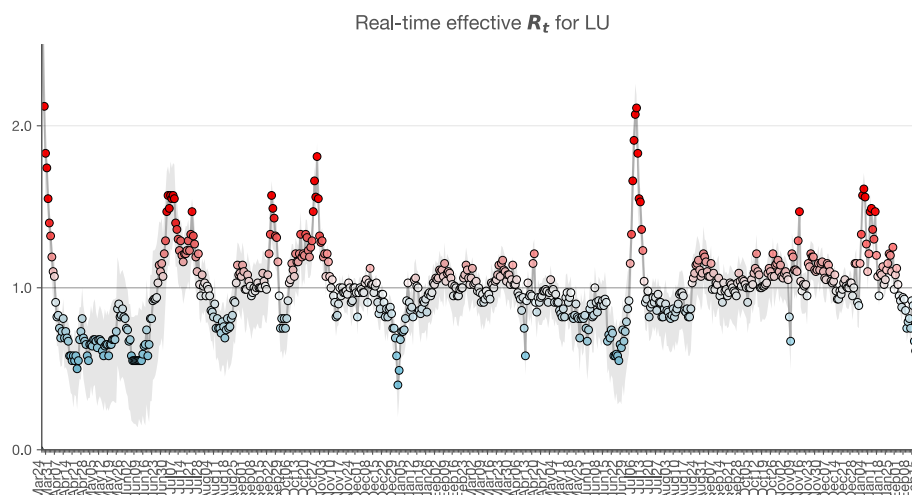
Figure 1. For the current week, the effective reproduction R_{eff} has remained constant at 0.61 today compared to 0.6 on Thursday of last week. The 7-day average of the current week has decreased to 0.62 compared to 0.77 of last week.
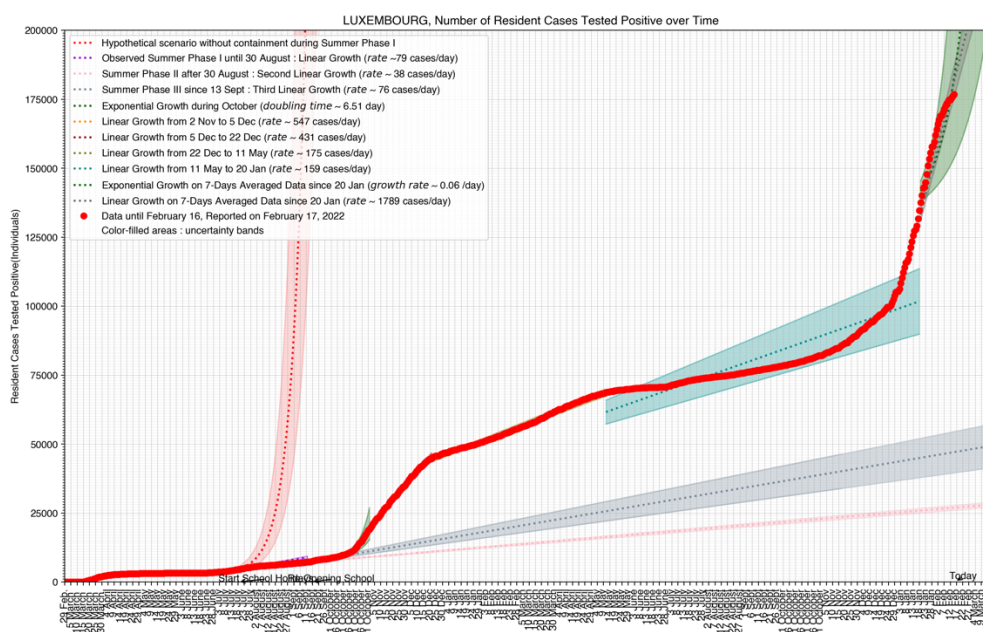

*Figure 2. Official COVID-19 case numbers up to 16 February (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded). **The dynamics during the current week indicates an exponential (green) regime and a linear fit (grey) exhibits a rather constant slope of 2,100 cases/day** compared to 2,037 cases/day for the fit of last week.*
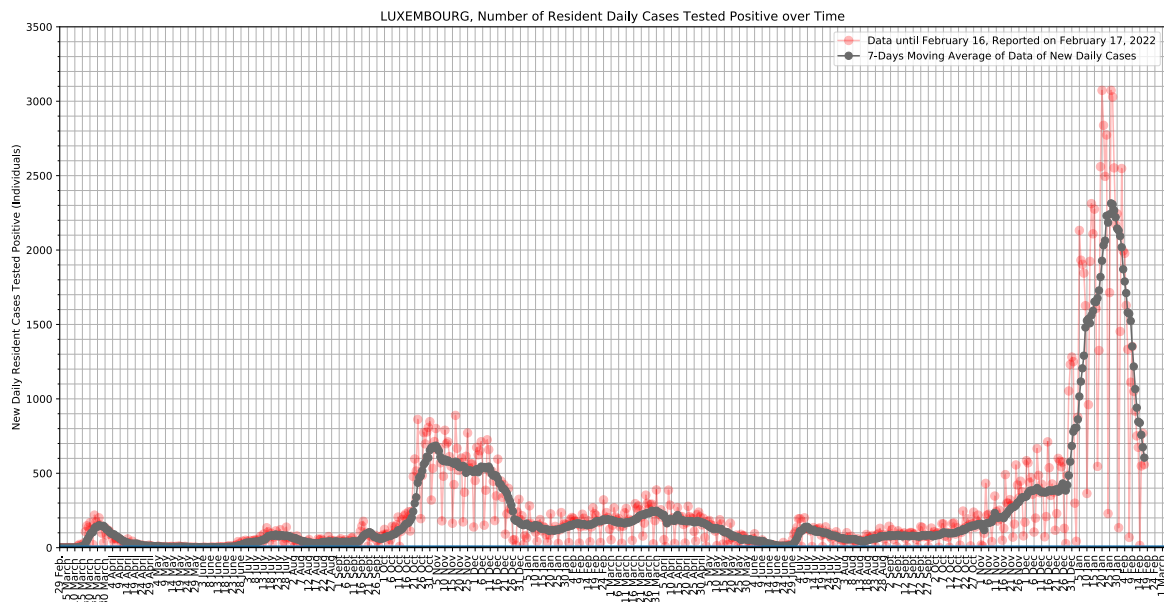
Figure 3. *The daily COVID-19 cases numbers up to 16 February (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line.* **For the current week, the 7-day average of daily cases (grey) has further decreased to 605 cases/day compared to 1,217 cases/day for the week before**, *which corresponds to a decrease of 50% compared to a 35% decrease last week.*

To assess the future epidemiological development in Luxembourg, we parameterized an extended epidemiological SIR model with data from Luxembourg by a Kalman filter. The model considers high and low risk groups, the current state of vaccination, and the vaccine efficacy against transmission for the Delta variant inferred from Luxembourg data as 44% and 68% for the first and the second dose, respectively, and the efficacy against severe outcome as 74% and 85%, respectively. For the Omicron variant, the transmissibility is increased by roughly 200%. However, the hospitalization risk is reduced by 60% for normal care and 80% for ICU compared to the Delta variant. Based on these assumptions and the current age-distribution of infected persons of the last two weeks, the model integrates the dynamics of daily cases, hospitalizations and ICU occupancy and projects the future development of the epidemics. Note that the model does not consider future changes in social behavior or vaccine efficacies explicitly and that the projections are accompanied by uncertainties as shown by the confidence intervals, which currently correspond to an 13% decrease or increase in social interactions for the optimistic and pessimistic scenarios (Figures 4 to 6).

The midterm **projections of the 7-day average of daily new cases** (Figure 4) estimate the current level of social interactions and consider the vaccination status. The projections reflect the current trend and the corresponding projections for **the 7-day average of daily cases** indicates a continuing relaxation for the next weeks (Figure 4 left) with a slightly faster trend than anticipated from last week's projections (Figure 4 right) probably due to the current vacation period. The stabilized regime is further indicated by the optimistic and pessimistic scenario corresponding to 13% change in social interaction which do not lead to a major difference in expected case numbers of around 300 cases/day on average at the beginning of March. Note that in some countries the relaxing trend was followed by stagnation of even moderate increase potentially due to increased social interactions. Hence, the epidemic dynamics will also depend on the future development of social life and potential import cases associated to the ski vacation period, including different virus variants.
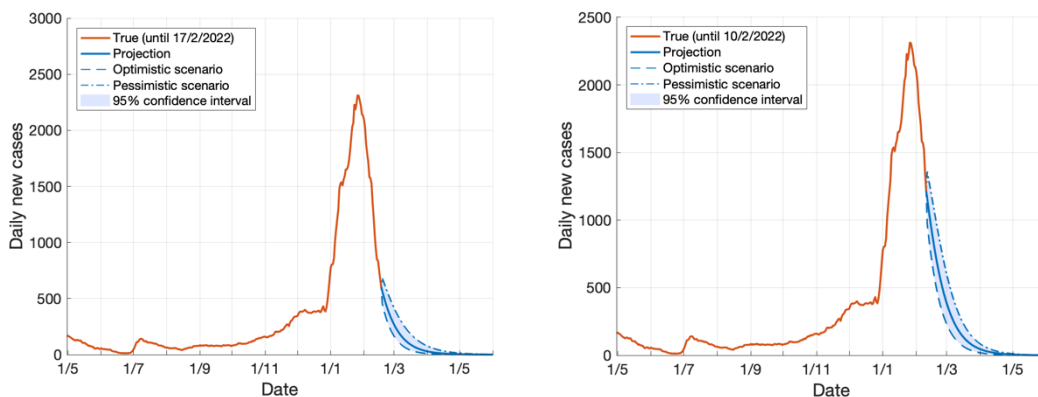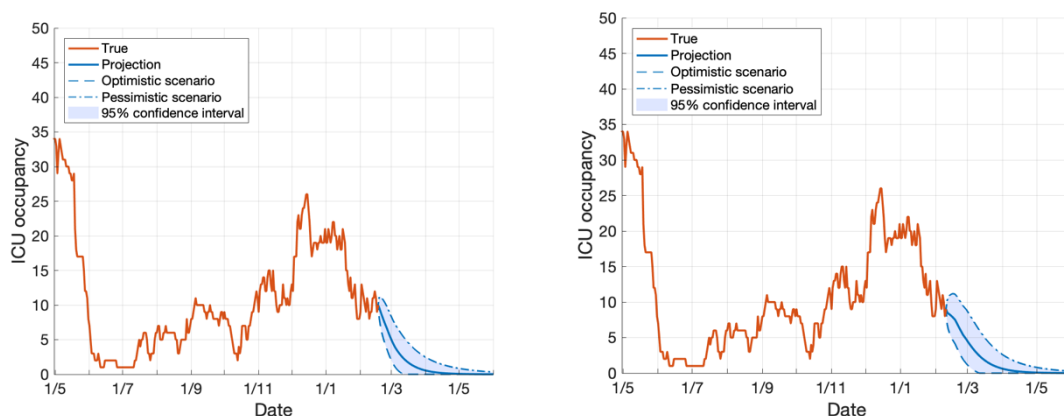
Figure 4. *Comparison of midterm projections for the 7-day average of daily cases from this week (left) and last week (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to an 13% and 11% decrease and increase in social interactions for this week's and last week's projections, respectively.* ***The comparison indicates a continuing decrease in the 7-day average for the next weeks with around 300 cases/day beginning of March compared to 500 cases/day from the projection of last week (right).***

The model **projection for normal care** assumes a 60% decrease in the hospitalization risk for the Omicron variant compared to the Delta variant. The current relaxation in daily case numbers (Figure 4) suggests a continuing decrease in normal care demands with around 20 beds at the beginning of March (Figure 5). This dynamics is based on the case numbers shown in Figure 4 and the current age distribution of cases. For the normal care demands, the relaxing epidemic regime is also reflected by minor changes in hospitalizations for the optimistic and pessimistic scenarios with an 13% increase in social interactions (Figure 5 left). Note that hospitalizations strongly depend on the age distribution of cases since older people are more likely to develop severe symptoms and that booster shots are essential to push down the curve, particularly for the Omicron variant. Hence, changes in the age distribution and the administration of booster shots can significantly modify the projections.
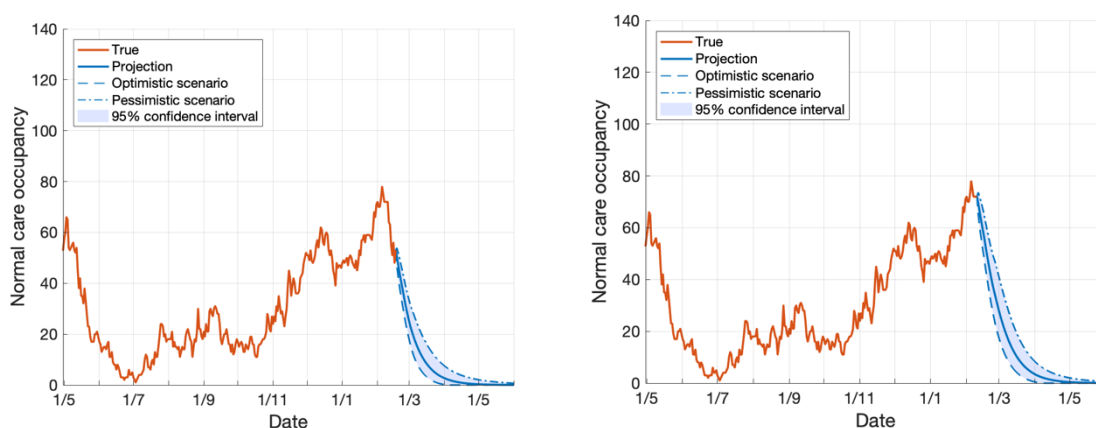

Figure 5. *Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to an 13% decrease and increase in social interactions, respectively for this week, and 11% for the projections from last week.* ***The comparison indicates a continuing decrease for the next weeks (left) similar to the projections of last week (right)****. The more stable epidemic regime is further indicated by the rather similar normal care demands for the pessimistic scenario with an 13% increase in social interactions.*
.

The corresponding **projections for ICU demands** also reflect the reduced hospitalization risk for the Omicron variant and relaxed epidemic dynamics. Together with the current age distribution of cases, the projections with the adapted hospitalization risk indicate a slow decrease in the ICU bed demands for the next weeks from the current level of 10 beds (Fig. 6 left) similar to the projection of last week (Fig. 6 right). The pessimistic scenario with an 13% increase in social interactions indicates a slightly slower decrease of cases. Note that hospitalization and specifically ICU demands strongly depend on the age structure and vaccination status of cases. Hence, it is particularly important that vulnerable people are vaccinated (including booster shots) and remain cautious in their social interactions to prevent severe cases. Therefore, the projections are accompanied by uncertainties.


Figure 6. *Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to an 13% decrease and increase in social interactions, respectively for this week and an 11% change for the projection of last week.* **The comparison exhibits a slowly decreasing ICU demands for the next weeks (left) similar to the projection of last week's projections (right).** *The current pessimistic scenario with an 13% increase in social interactions exhibits slower but persistent decrease in ICU demand.*
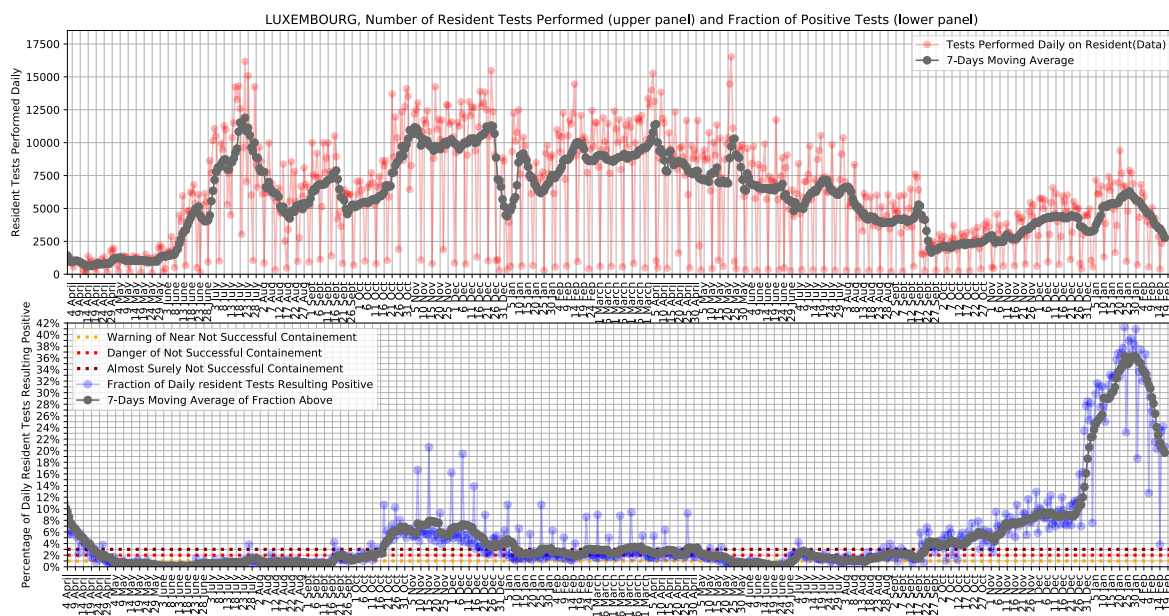

Figure 7. *Number of daily tests performed (top) and overall normalized positive tests (bottom).* **During the current week, the 7-day average of positivity rate (grey) has further decreased to 20%** *compared to around 25% last week.*
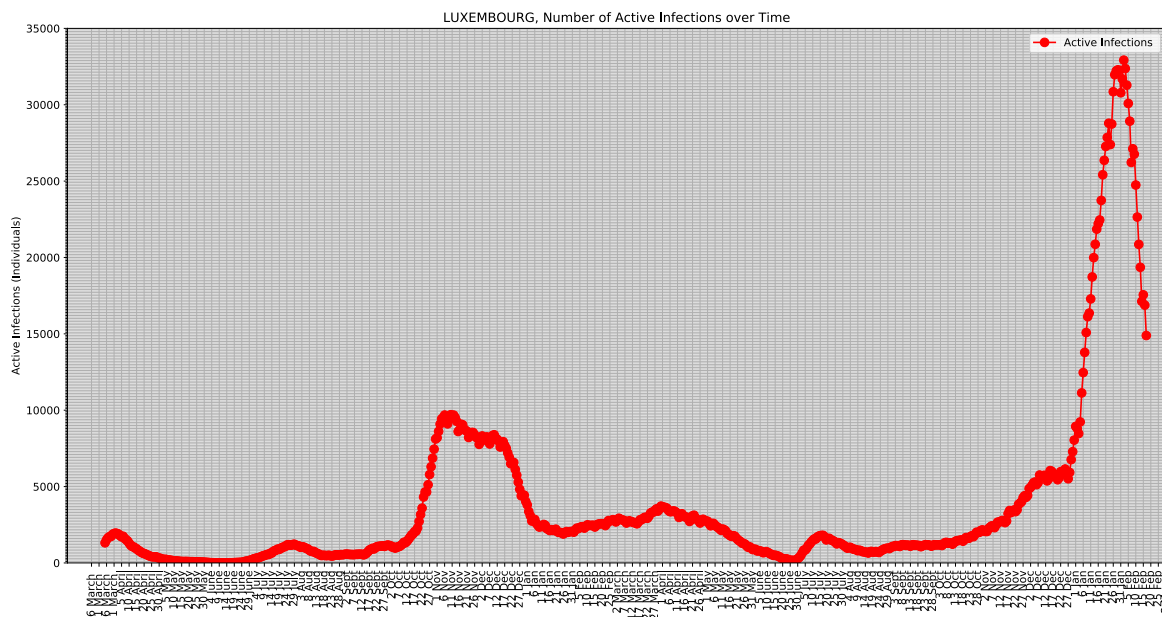
Figure 8. *During the current week,* ***the number of estimated active cases has further significantly decreased by 40% to 14,890 cases*** *compared to 24,729 cases last week.*
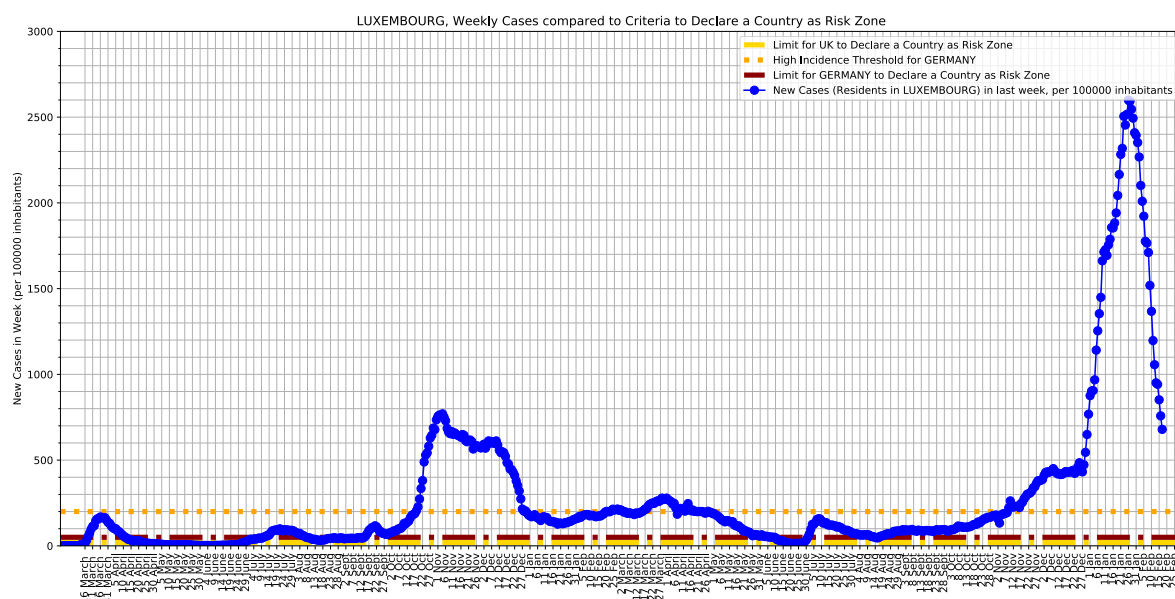
Figure 9. *Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line).* ***During the current week, the number of weekly cases per 100,000 inhabitants has further decreased to around 700 cases for this week compared to around 1,400 cases last week.***